SUMMARY OF RESULTS FROM THE CALIFORNIA PESTICIDE ILLNESS SURVEILLANCE PROGRAM - 2008 -

HS-1883

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November 22, 2010

Pesticide Illness Surveillance Program – 2008

Executive Summary:

This report describes illnesses identified by the Pesticide Illness Surveillance Program of the California Department of Pesticide Regulation (DPR) during 2008. DPR assigned 1,275 cases for investigation in 2008, a 14% drop relative to the 1,479 cases assigned in 2007, but within the range typical of recent years. The California Poison Control System (CPCS) remained a major source of case identification. Of the 1,275 cases initiated in 2008, CPCS transmitted reports of 562 (44%) (a minor increase from the 538 reported in 2007).

DPR scientists concluded that pesticide exposure had been at least a possible contributing factor to 895 (70%) of the 1,275 cases. Agriculture was the source of pesticide exposure in 311 (35%) of the 895 cases.

In 2008, DPR's pesticide safety outreach efforts included publication of a community guide to recognizing and reporting pesticide problems. The guide is available in English and Spanish. In 2008, Worker Health and Safety Branch outreach workers distributed copies of the community guide along with other safety information at about 60 health and service oriented events attended by an estimated total of thirty thousand people at risk, with Spanish-speaking farm workers and their families heavily represented. A bicultural worker also gave four interviews to Spanish-language broadcast media, potentially reaching thousands more. DPR also sponsored training at each CPCS division to assure that poison control specialists have access to accurate and timely information on pesticide characteristics.

Computer upgrades increased protection for confidential information while facilitating collaboration with agricultural commissioners and partners at state and federal agencies. DPR also continues to facilitate calls to agricultural commissioners via a statewide toll free phone number (1-87-PestLine, or 1-877-378-5463) and to participate in the Border 2012 project, helping to coordinate border-area focus groups and plan for international cooperation in illness surveillance.

Background on the Reporting System

The Department of Pesticide Regulation (DPR) administers the California pesticide safety program, widely regarded as the most stringent in the nation. Mandatory reporting of pesticide[1] illnesses has been part of this comprehensive program since 1971. Illness reports are collected, evaluated, and analyzed by the Pesticide Illness Surveillance Program (PISP). PISP is the oldest and largest program of its kind in the nation; its scientists provide data to regulators, advocates, industry, and individual citizens.

The U.S. Environmental Protection Agency (U.S. EPA) and the National Institute for Occupational Safety and Health (NIOSH) have encouraged other states to develop programs similar to PISP. Through the NIOSH Sentinel Event Notification System for Occupational Risk (SENSOR), federal grants partially support programs in the states of Iowa, Michigan, New York, and Washington. SENSOR also provides technical assistance to the states of Arizona, Florida, Louisiana, New Mexico, North Carolina, Oregon, and Texas. In addition, it supports pesticide-related work by the Occupational Health Branch of the California Department of Public Health (CDPH), which coordinates with DPR's Worker Health & Safety (WHS) Branch. U.S. EPA continues to rely heavily on California data for evidence of pesticide adverse effects because of the large volume of cases and long historical perspective that PISP provides.

DPR scientists participate in the national working group on pesticide illness surveillance that NIOSH convened to develop standards for information collection. In 1998, DPR expanded the PISP database and incorporated several features from the NIOSH standards. These upgrades

[1] "Pesticide" is used to describe many substances that control pests. Pests may be insects, fungi, weeds, rodents, nematodes, algae, viruses, or bacteria -- almost any living organisms that cause damage or economic loss, or transmit or produce disease. Therefore, pesticides include herbicides, fungicides, insecticides, rodenticides, and disinfectants, as well as insect growth regulators. In California, adjuvants are also subject to the regulations that control pesticides. Adjuvants are substances added to enhance the efficacy of a pesticide, and include emulsifiers, spreaders, and wetting and dispersing agents.

have been applied to all data collected from 1992 through the present. Data earlier than 1992 will be presented when historical perspective is required.

Excessive exposure to pesticides may cause illness by various mechanisms, and the surveillance program attempts to collect information about all of them. Every pesticide active ingredient has a mechanism of action by which it controls its target pests. Pesticide products may have other potentially harmful properties in addition to the qualities intended to control pests. PISP collects information on any adverse effects from any component of pesticide products, including the active ingredients, inert ingredients, impurities, and breakdown products. DPR has a mission to mitigate any pesticide exposure that compromises health or safety. This responsibility applies to health effects from products that act as irritants or as allergens, through their smells or by causing fires or explosions, as well as to classical toxic effects.

Sources of Illness Information

Under a statute enacted in 1971 and amended in 1977 (now codified as Health and Safety Code section 105200), California physicians are required to report any suspected case of pesticide-related illness or injury by telephone to the local health officer within 24 hours of examining the patient. This law applies to all types of pesticides (e.g., insecticides, herbicides, disinfectants) and to any location (e.g., farm, home, office). Each California county has a health officer with broad responsibility for safeguarding public health. A few cities employ their own health officers, with comparable responsibilities. These officials may investigate pesticide incidents to the extent necessary to fulfill their mandates. The law only requires them to inform the county agricultural commissioner (CAC) and to complete a pesticide illness report (PIR), which they send to the Office of Environmental Health Hazard Assessment (OEHHA), the Department of Industrial Relations (DIR), and DPR. Unfortunately, this reporting pathway identifies only a minority of the cases investigated.

DPR strives to ensure that PISP captures the majority of significant illness incidents and records them in its database. To identify pesticide cases that may go unreported by doctors, DPR has negotiated a memorandum of understanding with DIR and CDPH, under which DPR scientists review copies of the Doctor's First Report of Occupational Illness and Injury (DFROII), documents that the California Labor Code requires workers' compensation claims payers to forward to DIR. Scientists select for investigation any DFROII that mentions a pesticide, or pesticides in general, as a possible cause of injury. Reports that mention unspecified chemicals are also investigated if the occupation or setting is one in which pesticide use is likely. From 1983 through 1998, DFROII review identified the majority of the cases investigated.

In 1999, the California Poison Control System (CPCS) began assisting in pesticide illness reporting. Cooperation with CPCS identified hundreds of symptomatic exposures that otherwise would have escaped detection, but the 2002 state budget crisis prevented continuation of the contract after federal funding ended. When DPR's financial footing improved, the Department renewed its contract with CPCS in 2006. CPCS facilitation of illness reporting resumed in October 2006. DPR also continues to cooperate with OEHHA in efforts to provide the public and the health care community with information on pesticide safety and public health surveillance.

Agricultural commissioners investigate all identified pesticide illnesses that occur in their jurisdictions, whether or not they involve agriculture. They attempt to locate and interview all people with knowledge of the exposure events, collect samples when useful, and review relevant records. When appropriate, they request authorization from the affected people to obtain relevant portions of their medical records to include with the investigative reports. Medical record authorizations comply with the federal Health Insurance Portability and Accountability Act (HIPAA) and include commitments to maintain confidentiality in accordance with the California Information Practices Act.

DPR provides instructions, training and technical support for investigators. The instructions include directions for when and how to collect samples of foliage, clothing, or surface residues to document environmental exposures. As part of the technical support, DPR contracts with a California Department of Food and Agriculture Center of Analytical Chemistry to analyze the samples.

When investigations are complete, CACs send reports to DPR describing their findings. These reports describe the circumstances that may have led to pesticide exposure and the consequences to the exposed individuals. In their role as enforcement agents, CACs also determine whether pesticide users complied with safety requirements.

In an exception to the procedure described above, DPR recommends that CACs not contact people who attempted suicide or their families. CACs learn what they can from ancillary sources, which are often constrained by confidentiality considerations. DPR advocates respect for the privacy of people in difficult circumstances, and for that reason will forego collecting information of toxicological interest.

Along with describing exposure circumstances and other related case information, the CAC's investigation reports identify all the people known to have been exposed. DPR staff add records to the PISP database for any people not previously reported by other mechanisms. DPR scientists evaluate medical reports and all information the CACs gather in the investigative process. They abstract and encode basic descriptors of the event. They then undertake a complex synthesis of all available evidence to assess the likelihood that pesticide exposure caused the incident. Standards for the determination are described in the PISP program brochure, "Preventing Pesticide Illness," which can be viewed or downloaded from DPR's Web site at http://www.cdpr.ca.gov/docs/whs/pisp/brochure.pdf.

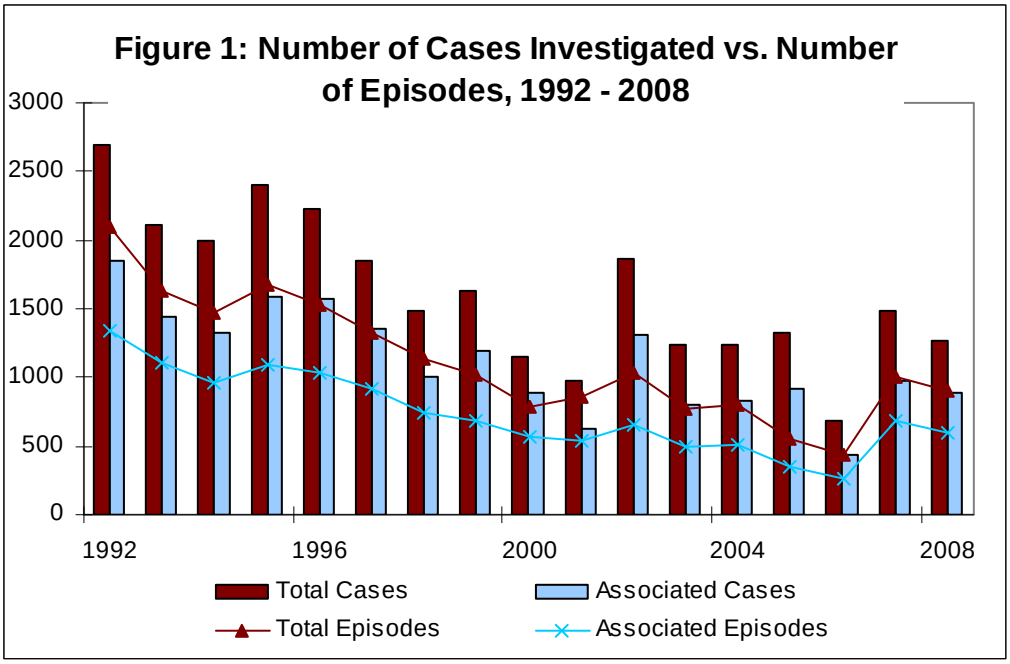
Purpose of Pesticide Illness Surveillance

DPR maintains its surveillance of human health effects of pesticide exposure in order to evaluate the circumstances of pesticide exposures that result in illness. DPR scientists regularly consult the PISP database to evaluate the effectiveness of DPR's pesticide safety regulatory programs and assess need for changes. If illness reports indicate excessive risk, DPR may implement additional California restrictions on pesticide use by providing CACs with recommendations for permit conditions or by changing regulations. For example, DPR may adjust the restricted entry interval (REI) following pesticide application, specify buffer zones or other application conditions, or require pesticide handlers to use protective equipment that meets certain standards. In some instances, changes to pesticide labels provide the most appropriate mitigation measures. Since the U.S. EPA has exclusive authority to require label changes, DPR cooperates with U.S. EPA to develop appropriate instructions for users throughout the country or, alternatively, for a California-specific label. If an illness incident results from illegal practices, state and county enforcement staff take appropriate action to deter future incidents.

During 2008, WHS incorporated illness data into a finalized risk characterization document for endosulfan (Beauvais, 2008) and into an overview of phosphine-generating pesticides (Fong, Johnson, Schneider, 2008).

2008 Numeric Results – Totals

In 2008, DPR assigned 1,275 cases for investigation (see Figure 1). This represents a 14 percent decrease from the number of cases investigated in 2007, but remains within the range typical of recent years. Continued participation by CPCS provided 562 of the case reports.



A case is the Pesticide Illness Surveillance Program representation of a person whose health problems may relate to pesticide exposure.

An episode is an event in which a single source appears to have exposed one or more people (cases) to pesticides.

Associated cases are those evaluated as definitely, probably, or possibly related to pesticide exposure. A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable. A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

Associated episodes are those in which at least one case was evaluated as associated.

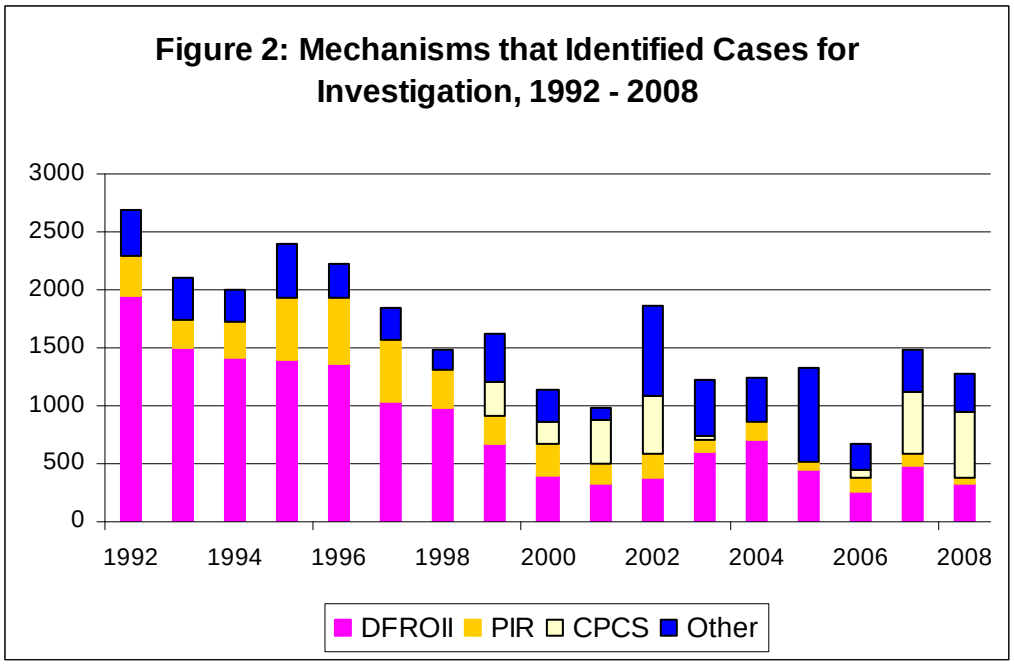
DPR will continue to explore ways to improve identification of pesticide illnesses. Current initiatives focus primarily on education to familiarize medical workers and potential victims with the importance of reporting pesticide illnesses. Along with safety strategies, DPR includes information on protective laws and regulations in material for farm workers and other groups potentially isolated by poverty and/or lack of English fluency. This material features explanations of the surveillance program, the legal requirement for reporting, and legal safeguards against retaliation. During 2008, DPR developed a "Community Guide to

Recognizing and Reporting Pesticide Problems," in English and Spanish, which encourages community members to communicate problems to competent authorities. DPR also distributes English and Spanish versions of a laminated pocket card with toll-free numbers people can call to get help for pesticide problems.

DPR also partners with OEHHA to make resources available to the medical community. In particular, during 2008 DPR and OEHHA presented training on pesticide resources to each division of CPCS. More recently, DPR released a protocol to help coroners investigate fatalities in which they suspect pesticide involvement (O'Malley, 2009). It includes broadly applicable information on availability of relevant clinical and toxicological tests.

Figure 2 demonstrates the variation in numbers of cases identified by the different sources as well as an overall downward trend. Investigations so far suggest the trend is probably real, but reliance on manual processing introduces uncertainty that complicates analysis. Automated means of identifying pesticide related illnesses, such as access to electronic access worker's compensation data, would greatly improve the reliability and consistency of these data. Figure 2 also reflects the fact that PISP receives a substantial number of reports outside of the standard PIR and DFROII-based pathways. Such episodes may come to the CACs' attention via emergency response contacts, news reports, through direct citizen complaints, or by their own observations.

When CACs investigate episodes, they record information about all the affected people they identify. If those people had not previously been reported, they are added to the database when CAC reports reach DPR.

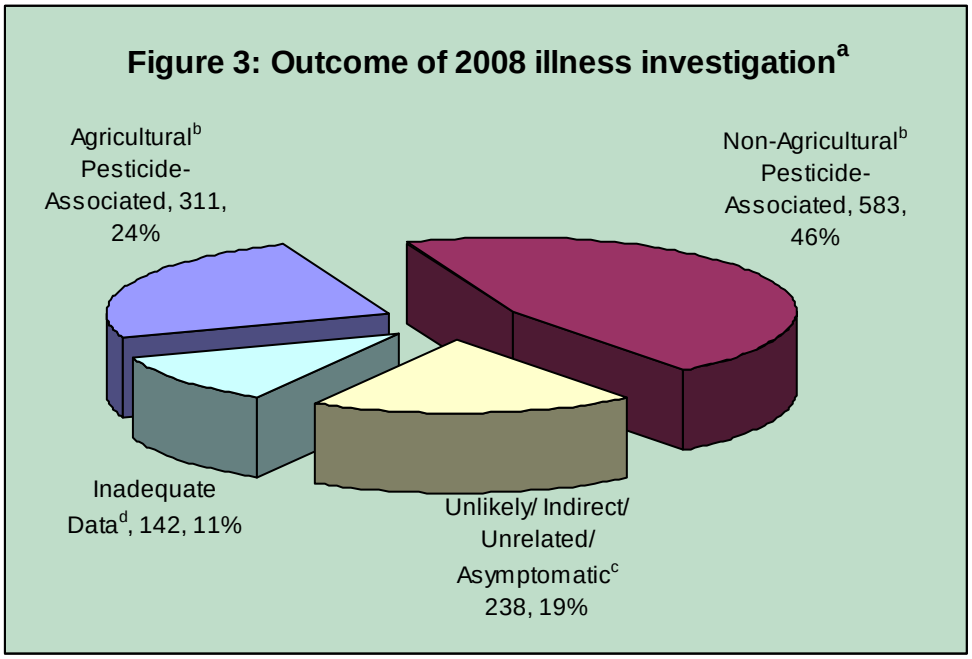


DFROII – Doctor's First Report of Occupational Illnesses and Injury (Workers' Compensation document).
PIR – Pesticide Illness Report (physician reporting in compliance with Health and Safety Code Section 105200).
CPCS – California Poison Control System (facilitated physician reporting).
Other – All other methods of case identification, including citizen complaints, contacts by emergency responders, and news reports.

DPR scientists found that pesticide exposure had been at least a possible contributing factor to 895 (70%) of the 1275 cases identified. PISP defines the term "pesticide-associated" as cases evaluated as definitely, probably, or possibly related to pesticide exposure, and "agricultural" as involving pesticides intended to contribute to production of an agricultural commodity, including livestock. All other exposure situations are designated "non-agricultural". This includes structural, sanitation, or home garden use, as well as pesticide manufacture, transport, storage, and disposal.

Of the 895 pesticide-associated cases, 311 (24% of the 1275 total cases) were attributed to pesticides used for agricultural purposes. Another 583 associated cases (46% of the total of

1275) occurred in non-agricultural circumstances. One case could not be characterized as agricultural or non-agricultural. Evidence indicated that pesticide exposure did not cause or contribute to ill health in 238 (19%) of the 1275 cases assigned for investigation. Insufficient information prevented evaluation of 142 cases (11%) (Figure 3).



[a] Total cases investigated = 1275
[b] *Agricultural* and *Nonagricultural* refer to the intended use of the pesticides definitely, probably, or possibly related to human health effects. This chart omits one case that could not be characterized as agricultural or non-agricultural.
[c] *Unlikely/Indirect/Unrelated/Asymptomatic* refers to cases in which the weight of the evidence was against pesticide causation. This occurs when exposed people did not develop symptoms, or if symptoms were not caused or were unlikely to have been caused by pesticide exposure.
[d] *Inadequate* means that there was not enough data available or reported to determine if pesticides contributed to ill health.

Table 1 shows the numbers of cases evaluated at each level of relationship. Among the 895 pesticide-associated cases, evidence established a definite relationship to pesticide exposure for 105 (12%), a probable relationship for 544 (61%), and a possible relationship for 246 (27%) (Table 1).

Table 1: Relationship Evaluation of 2008 Illness Investigations

Relationship	Relation to Agriculture			Total
	Agricultural[a]	Non-Agricultural	Unknown or Not Applicable [j]	
Definite[b]	8	97	0	105
Probable[c]	221	323	0	544
Possible[d]	82	163	1	246
Pesticide-Associated Subtotal	**311**	**583**	**1**	**895**
Unlikely[e]	11	45	2	58
Indirect[f]	0	10	0	10
Asymptomatic[g]	35	15	0	50
Unrelated[h]	0	0	120	120
Not Applicable (inadequate data)[i]	20	98	24	142
Overall Total	**377**	**751**	**147**	**1275**

[a] Agricultural cases are those that implicate exposure to pesticides intended to contribute to the production of agricultural commodities.
[b] A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions.
[c] A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable.
[d] A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.
[e] An unlikely relationship indicates that a correlation cannot be ruled out absolutely. Medical and/or physical evidence suggest a cause other than pesticide exposure.
[f] An indirect relationship indicates that pesticide exposure is not responsible for symptomatology, but pesticide regulations or product label contributed in some way, (e.g., heat stress while wearing chemical resistant clothing).
[g] An asymptomatic relationship indicates that exposure occurred, but did not result in illness/injury.
[h] An unrelated relationship indicates definite evidence of causes other than pesticide exposure, including exposure to chemicals other than pesticides.
[i] A relationship of "not applicable" indicates that relationship cannot be established because the necessary information is not available to the evaluator.
[j] Agricultural designation is not applicable to cases unrelated to pesticide exposure.

Tabular summaries presenting different aspects of the data are available online at http://www.cdpr.ca.gov/docs/whs/currpisp.htm, or by contacting the WHS Branch. Internet users now have the additional option of using the query program, CalPIQ, to develop reports to their own specifications. CalPIQ is available at http://apps.cdpr.ca.gov/CalPIQ and can retrieve any cases evaluated as definitely, probably, or possibly related to pesticides from 1992 through the most recent year completed. Users can specify which cases to retrieve based on county of occurrence, year of identification, whether or not agriculture was the source of pesticide exposure, the identity of the implicated pesticide(s), the type of location where exposure occurred (e.g., farm, school), the intended pesticide application site (e.g., grapes, food handling equipment), the manner of exposure (e.g., drift, direct spray), and/or activity of the affected people (e.g., applicator, field worker). Users can direct CalPIQ to retrieve either descriptions of each individual case or the total number of cases that match the selected criteria (summary report). If they select the summary report option, users may request subtotals by activity, county, type of exposure, type of location, and/or year of identification.

Occupational exposures (those that occurred while the affected people were at work) accounted for 552 (62%) of the 895 pesticide-associated cases from 2008. Occupational exposures typically predominate among the cases PISP collects, reflecting the impact of DFROIIs (workers' compensation documents) for identifying cases. Non-occupational exposures accounted for 341 pesticide-associated cases (38% of the total). Two pesticide-associated cases could not be characterized as occupational or non-occupational.

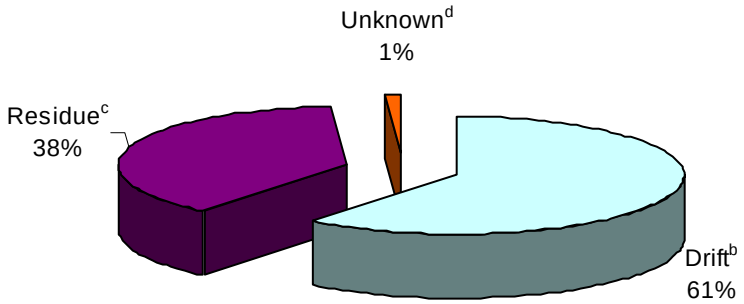
Enforcement actions often are still under consideration when DPR receives the illness investigative reports, thus identification of violations is difficult. Based on the information available at the time of evaluation, WHS scientists concluded that 441 (49%) of the 895 pesticide-associated cases provided evidence that violation of safety requirements had contributed to exposure, and harm might have been avoided if all the people involved had adhered strictly to safety procedures already required by regulations and pesticide labels. In 143

cases (16%), violations were identified but judged not to have contributed to pesticide exposure; scientists remained uncertain whether violations contributed to 67 cases (7%). In 244 (27%) of the pesticide-associated cases, health effects were attributed to pesticide exposure in spite of apparent compliance with all applicable label instructions and safety regulations. Further evaluation of these cases is needed to determine if additional safety requirements are appropriate.

Agricultural Field Worker Incidents

In 2008, 194 cases of field worker illness or injury were evaluated as definitely, probably or possibly related to pesticide exposure. One-hundred-nineteen of these cases involved exposure in 14 drift episodes while 73 involved exposure to pesticide residue in 15 separate episodes. The exposures of the remaining two cases could not be characterized with confidence (Figure 4).

Figure 4: Field Worker Exposure to Pesticides, 2008[a]



[a]Total pesticide-associated field worker cases = 194
[b] Drift refers to field worker cases associated with exposure to off-site movement of a pesticide from an application.
[c] Residue refers to field worker cases associated with exposure to residue from a previously applied pesticide.
[d] Unknown indicates that PISP Scientists could not determine how field worker exposure occurred

Residue: Fifty of the 73 residue exposures were evaluated as probably related to reported health effects. The other 23 field worker residue exposures were evaluated as possibly related.

Fifty-six (77 %) of the residue exposures were associated with a single episode in Monterey County. Approximately seventy strawberry harvesters (including supervisors) started work in an area that had last been sprayed nearly a month earlier. Crew members began to develop symptoms as they moved into a section of the field treated three days earlier with the fungicides captan and myclobutanil and the insecticides fenpropathrin and naled. Most workers developed nose, eye and upper respiratory tract irritation; but as the morning progressed, some workers felt nauseated and developed headaches. Three-and-a-half hours after they had started working, a majority of the crew complained of symptoms, and the field supervisor informed the grower. The grower visited the worksite where she, too, soon developed respiratory symptoms. About two hours after she arrived, she offered the crew the choice of going home or seeking medical care.

Investigators interviewed 65 crew members. Fifty-six of them reported having had health effects. Some workers said they were not offered the option of going for medical care. All the workers went home.

The crew entered the field legally, as the REI (time required to allow for pesticide dissipation) for that section of the field had elapsed. No other source of pesticide exposure could be identified, however. No reported pesticide applications occurred within 2500 feet of the field on the day that the crew was harvesting strawberries. The most recent aerial application occurred the day before, 900 feet away. A few workers described more recent nearby applications but these applications were not documented and could not be verified. Nineteen workers, two of whom had asthma and one of whom had allergies, said they detected an odor. Some workers said they observed “dust” while harvesting, but the dust was not identified. DPR scientists concluded that 48 of the workers had probably reacted to residues of captan, myclobutanil, fenpropathrin, and naled, and that this exposure was a possible factor in the symptoms the other eight experienced.

The Monterey County agricultural commissioner found that the grower violated regulations when she did not take her workers for medical care when she suspected they suffered from pesticide toxicity. She also failed to submit required pesticide use reports in the designated time frame. These violations did not contribute to exposure or illness.

Among the other 17 field workers exposed to residue, two were exposed when they entered treated fields prior to the expiration of the REIs. In one instance, a supervisor had removed the warning signs from the treated field four hours before the end of a 24-hour REI and had sent a worker into the field. The grower called the agricultural commissioner, reported the violation, and fired the supervisor. The other reentry violation involved a worker who saw an application in progress and moved to another location. He returned later and mowed a nearby orchard, not knowing that it had been sprayed three hours earlier with a pesticide that requires a 12-hour REI. The operator of the property was at fault for not informing the employee of the applications.

Drift: Drift probably caused or contributed to the symptoms experienced by 90 field workers, and was a possible factor in 29 field worker illnesses. Six of the episodes each affected just one worker. The other eight episodes affected a total of 113 workers.

The largest field worker drift episode occurred in Imperial County, where malathion drifted from an aerial application to alfalfa onto three farm labor crews harvesting a broccoli field half a mile away. Crew leaders initially approved the application, but workers from all three crews soon reported that they smelled a strong, nauseating odor. One crew immediately stopped working and left the field. Those workers stayed well. The other two crews continued working, and workers soon began feeling ill. The foremen then told the workers to leave the field, and took the four workers who were vomiting to a hospital where they showered and changed clothes. Another worker reported persistent symptoms five days later and was sent for care at that point.

Workers, the application spotter, and a local weather station all agreed the wind blew from the application site towards the workers. Environmental samples identified small but unambiguous amounts of drift. A field worker donated his shirt for analysis, and malathion was detected in it,

too. Because of the likelihood of contamination, the grower discarded the broccoli harvested that day and delayed completing the harvest until the investigators' samples showed residues on the crop to be within tolerance.

The Imperial County Agricultural Commissioner was able to interview 46 workers, all based in Arizona. Thirty-four workers, including a farm labor contractor's safety coordinator, reported health effects. Effects on 33 were evaluated as probably due to malathion exposure, and the other symptomatic case was evaluated as possibly related. The other 12 field workers denied experiencing symptoms. The applicator paid a fine of $5,000.

Three field worker drift episodes occurred in Monterey County. WHS helped to investigate the largest of these, in which 25 workers were exposed to methyl isothiocyanate (MITC), a breakdown product of the fumigant metam-sodium (Hernandez, 2010). Two blocks, both of which adjoined the field where the workers were assigned, had been fumigated earlier that morning. Equipment failure delayed application of the required post-application water treatments to the treated site. The workers left the area when they developed symptoms suggestive of exposure to MITC escaping from the treated field.

In both fields, WHS scientists observed evidence of shortcomings beyond the delayed water seal. In one, large soil clods indicated poor soil preparation, which would allow MITC to off-gas rapidly. In the other, the scientists noticed linear depressions atop some of the beds. This suggested that the press roller did not properly close the injector traces in the treated beds, allowing MITC to escape. The scientists followed up by inspecting the application equipment and found the press roller was misaligned, leading to the malfunction the scientists had inferred, and also that the roller was mounted at a fixed height and did not exert pressure on the soil as it should.

In field worker drift episodes, the workers often smelled odors and felt that foremen overtly or subtly delayed or discouraged them from leaving work to seek medical care. Since the only crew to escape widespread illness was the one that left the field immediately upon sensing drift, it

might seem that prompt departure should be recommended. This summary cannot account, however, for the number of times that workers remained well and continued their jobs in spite of odor. Such episodes are not reported to illness surveillance (since no one is ill). Without knowing how frequently field crews smell odors and remain well, we cannot draw firm conclusions about the episodes in which workers smell odors and get sick.

Drift Exposure

The PISP defines drift exposure as exposure to pesticide "spray, mist, fumes, or odor carried from the target site by air." This definition differs from the regulatory definition in that the PISP definition includes exposures to fumigants that escape confinement. Additionally, the PISP definition of drift includes episodes in which air movement carried pesticide and caused exposure of pesticide handlers. (Regulations provide specific protections for pesticide handlers, who perform tasks such as applications and preparations for applications.) Airborne exposure of handlers is not drift in the usual sense, but recording it provides information about the mechanism of exposure to pesticide users.

In 2008, DPR recorded a total of 285 individuals who reported symptoms evaluated as definitely, probably, or possibly related to exposure to drift (Table 2) in 127 separate episodes. One non-agricultural episode is counted twice in Table 2, because it affected both the applicator (a woman who combined incompatible cleaning products) and her mother, who smelled the irritant gas and went to get her daughter.

The major field worker episodes are described above, in the section on field workers. Non-agricultural drift affected primarily pesticide handlers. Antimicrobial pesticides were the major class implicated. Agricultural drift affected two large groups of people other than field workers.

Table 2: Pesticide Drift Episodes that Occurred During 2008					
Type of Pesticide	Activity of Affected Individuals [a]	Agricultural [b]		Non-Agricultural [b]	
		Episodes [c]	Affected Individuals [d]	Episodes [e]	Affected Individuals [d]
Insecticides					
	Handlers	1	1	9	9
	Field Workers	4	37	0	0
	Others	3	3	8	8
Fumigants					
	Handlers	1	1	0	0
	Field Workers	2	39	0	0
Antimicrobials					
	Handlers	1	1	57	58
	Others	0	0	19	22
Other					
	Handlers	2	2	6	6
	Field Workers	8	43	0	0
	Others	5	53	3	3
Total					
	Handlers	5	5	72	73
	Field Workers	14	119	0	0
	Others	8	56	30	33

[a] Describes the people's activity at the time of exposure. Handlers include people mixing, loading and applying pesticides, repairing pesticide equipment and flagging for aerial application. Field Workers are people working in agricultural fields at the time of drift exposure.

[b] Designation as agricultural indicates exposure to pesticides intended to contribute to production of an agricultural commodity, including livestock. Any other exposure situation is designated non-agricultural.

[c] Number of people who developed symptoms evaluated as definitely, probably, or possibly caused or exacerbated by pesticide exposure. A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable. A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

[d] One antimicrobial episode appears twice, as affecting an applicator and as affecting another person.

One large agricultural drift episode occurred when residents in their homes smelled the herbicide bensulide and the insecticide chlorpyrifos applied to a broccoli field about 100 yards away. Monterey County investigators canvassed the neighborhood and identified 24 members of 11 households who experienced symptoms, which were evaluated as probably attributable to drift exposure. The investigators left questionnaires at homes where no one answered the door, but none of the questionnaires was returned.

The other major episode occurred at a citrus packing plant where an additional product, an antimicrobial containing hydrogen peroxide and peroxyacetic acid, was fed into a system that treated lemons with the fungicide imazalil. The antimicrobial label prohibited mixing with anything other than water, so the use was not legitimate. The plant also disregarded a label prohibition against using a solution of the product more than once.

On the second day that the plant used the two products together, 21 workers developed symptoms attributed to vapor drifting from the system, and two others had multiple forms of exposure. Among the 21 who attributed symptoms to drift exposure, PISP scientists evaluated 19 as probably related and two as possibly related. The company paid a total fine of $16,840 for violations identified during investigation of this episode.

Morbidity and Mortality

Among the 895 cases evaluated as associated with pesticide exposure, 34 people were hospitalized and 117 people reported lost time from work (or normal activity, such as going to school). Approximately 56% (19 of 34) of the reported hospitalizations were due to ingestion of pesticides (18 intentional, one by an autistic man with a history of eating non-food items and who ultimately died of this ingestion). Insecticides and rodenticides were the most commonly ingested pesticides.

Table 3: Summary of Pesticide-Associated[a] Hospitalization and Disability, 2008			
Relationship	**Total Cases**	**Number Hospitalized**	**Lost Work Time**
Definite/Probable[b]	649	23	87
Possible[c]	246	11	32
Total Cases	**895**	**34**	**119**

[a] Pesticide-associated cases are those in which pesticide exposure was evaluated as a definite, probable, or possible contributor to ill health.

[b] A definite relationship indicates a high degree of correlation between the pattern of exposure and resulting symptomatology. The relationship requires both physical evidence of exposure and medical evidence of consequent ill health to support the conclusions. A probable relationship indicates a relatively high degree of correlation between the pattern of exposure and resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable.

[c] A possible relationship indicates that health effects correspond generally to the reported exposure, but evidence is not available to support a relationship.

Drift exposure caused the second greatest number of hospitalizations (6 of 33, 18%). Four of the six drift cases involved people (including three known to have asthma) who mixed incompatible sanitizer/cleaning products and inhaled the resulting irritant gas; another breathed vapor from his spa.

In 2008, PISP received only one report of a child hospitalized due to pesticide exposure. A 15-month-old toddler toppled into a bucket of dilute pine oil sanitizer when her mother, who was mopping the kitchen floor, stepped away briefly to answer the door. When the mother returned 2-3 minutes later, she found her daughter had fallen into the 5-gallon bucket of diluted sanitizer. The child responded to rescue breathing and recovered after 4 to 5 days hospitalization.

Among the other eight hospitalized people, three were exposed to insecticides. Four were each exposed to a pesticide of different class: a fumigant, an antimicrobial, a fungicide, and a wood preservative. The one other person was exposed both to an herbicide and to a rodenticide.

DPR and CACs investigated three deaths in 2008. Two were related to pesticide exposures, both ingestions by adult males reported via CPCS. One fatality involved a suicidal insecticide ingestion. The other fatal case involved a severely autistic man who had a history of pica. He drank an unknown amount of herbicide he may have mistaken for juice. The third case was found not to have been caused by pesticide exposure. An ATV overturned and crushed a rancher as he sprayed to control yellow starthistle.

A fourth death remains under investigation by the Orange County District Attorney. A woman died in custody after acknowledging that she broke into a house under fumigation.

An Emerging Hazard for Health Care Workers

Necessarily, health care facilities regularly use antimicrobial pesticides to maintain sanitation and protect patients and staff from infection. The products used for this essential function are often highly irritating, and several are known allergens. This results in occasional over-exposures to medical workers, as recently reported in a public health newsletter and reprinted in the Journal of the American Medical Association (Lee et al. 2010).

In 2006, PISP scientists began to notice a new pattern of exposure for health care workers: When workers pull sanitizing wipes from dispensers, often hurriedly, drops of sanitizer flick into their eyes. This pattern has persisted through subsequent years. In one case, an investigator learned that, in the five months between the time the first case occurred and the time the report was received and investigated, two more workers had encountered the same problem at the same hospital.

The workers generally denied having received training on safe and effective use of the sanitizers. Several commented that the product seemed to include more liquid than previously. None of the

affected health care workers used eye protection. To protect employees against this and other hazards, facilities that use sanitizers should consider encouraging routine use of eye protection, even if product labels do not require it.

Significance of CPCS Participation

CPCS report facilitation greatly strengthens illness surveillance: CPCS transmits reports more rapidly than other intermediaries, and CPCS identifies qualitatively different exposures from those the program identifies by other means. Table 4 summarizes these characteristics.

Table 4: Characteristics of Report Sources, 2008[a]

	CPCS[b]	Other PIRs[c]	DFROIIs[d]	Other Sources[e]
Median days in transit[f]	1	11	102	136
Average days in transit	3	44	154	209
Minimum days in transit	0	1	7	44
Maximum days in transit	74	392	469[g]	650
Non-occupational exposures	372	9	0	72
Occupational exposures	122	39	244	262
Exposures of children age < 10	106	2	0	10
Hospitalizations	40	2	0	0
Intentional exposures	41	0	1	1
Deaths	2	0	0	2

[a] Includes all case reports investigated, whether or not evaluated as associated with pesticide exposure.
[b] Cases reported via the California Poison Control System (CPCS).
[c] Cases for which physicians submitted Pesticide Illness Reports independently of CPCS.
[d] Cases identified through review of Doctor's First Reports of Occupational Illness or Injury
[e] Cases identified by other methods, including citizen complaints, contacts by emergency responders, and news reports.
[f] Days in transit represents the number of days elapsed between exposure and arrival of a report at DPR.
[g] One case, which could not be evaluated, attributed cancer to an exposure that occurred approximately 12,373 days earlier. This case was considered an outlier. The next longest DFROII transit time appears in the table.

"Other" source reports have long transit times because PISP generally does not learn of them until CACs submit investigation reports in which the cases are identified. The table shows,

however, that the "other" sources resemble the standard sources in that they identify primarily adult, occupational exposures. DPR relies almost entirely on CPCS for information about exposures of children and non-occupational exposures, which account for the majority of hospitalizations and deaths from pesticide exposure. Additionally, prompt notification enables more informative investigations.

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Appendix I: Acronyms

CAC	County Agricultural Commissioner
CDPH	California Department of Public Health
CPCS	California Poison Control System
DFROII	Doctor's First Reports of Occupational Illness and Injury
DIR	Department of Industrial Relations
DPR	California Department of Pesticide Regulation
HIPAA	Health Insurance Portability and Accountability Act
NIOSH	National Institute for Occupational Safety and Health
OEHHA	Office of Environmental Health Hazard Assessment
PIR	Pesticide Illness Report
PISP	Pesticide Illness Surveillance Program
REI	Restricted Entry Interval
SENSOR	Sentinel Event Notification System for Occupational Risk
U.S. EPA	United States Environmental Protection Agency
WHS	Worker Health and Safety Branch